

Mitigation of volcanic risk

Prevention, preparedness, and emergency response planning

by Peter Dunkley & Gill Norton,
Montserrat Volcano Observatory

More than 500 million people live in proximity to volcanoes. The potential therefore exists for major loss of life and damage to property and infrastructure, particularly where large urban areas are situated in volcanic areas. Mitigation of such losses may be achieved through planning. This ideally comprises an integrated three-pronged approach involving prevention, preparedness, and emergency response measures.

The most effective preventive measure is that of land-use planning, which limits or prohibits the development of hazardous areas. The need for such planning is well-exemplified by the destruction in 1985 of the Colombian city of Armero. Here 23 000 inhabitants perished as a result of mudflows produced by the melting of snow and ice during an eruption of Nevado del Ruiz volcano. Historical accounts indicate that the site of Armero had been inundated by volcanic mudflows on previous occasions. During one such event in 1845 several communities were destroyed. Clearly, land-use planning based upon historical precedent could be very effective in avoiding such catastrophes.



The incandescent glow of the lava dome lights the night sky, January 1997.

BGS © NERC. All the images in this article are products of the DFID programme of work carried out in Montserrat by the BGS.

the authorities and public are aware of the nature of the hazards and are familiar with emergency procedures.

When volcanic disasters occur, emergency response plans are implemented to minimise the impact. In the first instance such response tends to concentrate on search and rescue, medical treatment, shelter, and feeding. In the longer term, response measures include such activities as reparation, redevelopment, and resettlement.

Prevention activities are more effective than preparedness measures, because they reduce vulnerability on a long-term basis. This is particularly so when prevention is incorporated in the planning phase of development. A balance should, however, be maintained between prevention, preparedness, and emergency response plans. This ensures that the overall process of risk reduction is spread across a range of activities, so limiting the extent of damage, should certain measures fail.

Such a balanced approach to planning and managing risk has been adopted in response to the eruption of Soufrière Hills Volcano on the Caribbean island of Montserrat. The eruption began in 1995 and has been characterised by growth of an andesite lava dome on the summit region of the volcano. The main hazard associated with this activity is that of pyroclastic flows, produced by periodic collapses of the lava dome. These consist of fluidised mixtures of hot ash, gas, and rock debris with temperatures of 300 to 400°C that flow rapidly down the flanks of the volcano, occasionally with velocities exceeding 200 kilometres per hour. Explosive activity has also occurred, and in December 1997 the southern flanks of the volcano collapsed in a large debris avalanche accompanied by a lateral blast which completely obliterated two villages. The lava dome is currently undergoing a second phase of growth and is now considerably higher than at any stage in the past, and therefore potentially very dangerous.

The eruption has been devastating for this small island. Nineteen people have been killed and the southern two-thirds of the island have been evacuated. Here the infrastructure has been destroyed, including the airport and former capital of Plymouth, which lie buried under the

BGS © NERC



Observations and surveys give an indication of the level of activity of the dome.

debris of pyroclastic flows and mudflows. The original population of 11 000 dropped to as little as 2500 at the height of the crisis, although subsequent reconstruction has seen a gradual return of inhabitants to a current level of about 5000.

The activity of the volcano is monitored by the Montserrat Volcano Observatory (MVO), which is managed by the BGS under contract to the UK Department for International Development. Information from the monitoring programme is provided to the governments of Montserrat and the United Kingdom, where it is used to underpin development plans, as well as emergency preparedness and response plans. Methods of surveillance include: seismic monitoring; the monitoring of gas emissions; and the monitoring of ground deformation using global positioning systems, theodolites, and electrical distance measurements. A programme of public awareness and education is also actively pursued by the MVO.

Data from the monitoring programme are used in risk and hazard assessments, undertaken approximately every six months by a group of experienced scientists. These assessments provide numerical probabilities for various possible eruption scenarios which, combined with demographic information, can be used to quantify the risk to the population. The results of the assessments are used by the administrative authorities to help formulate reconstruction and development plans, and to ensure the safety of the island's population. The MVO also provides warnings

of eruptions, and gives advice for planning the day-to-day administration of exclusion zones. Warnings of ash clouds are also issued to regional and international aviation authorities in order to safeguard air transport.

Redevelopment of Montserrat continues apace in the northern part of the island. Without the continuous scientific monitoring of the volcano, and the information that this provides to the authorities on the risks, it would be impossible to

determine which areas were safe to inhabit, and where the future of Montserrat might lie.

For more information, contact:

Dr Peter Dunkley,
Director Montserrat Volcano
Observatory, Mongo Hill,
Montserrat, West Indies.
Tel: 1 664 491 5647
e-mail: peter@mvo.ms
website: www.mvo.ms



C. Wardle BGS © NERC

Montserrat volcano 'risk' map, presented after the first explosive activity on 17 September 1996. The zones A to G represent areas of decreasing risk. The alert level at any one time determines the status of each zone. Hazards include pyroclastic flows and rock and ash falls.